

Enhancement and suppression of the thermal emission in photonic crystals

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We investigate the general features of thermal emission and absorption of radiation in photonic crystals. The light-matter interaction is strongly affected by the presence of the three-dimensional photonic crystal and the alteration of the photonic density of states can be used to suppress or enhance the thermal emissivity and absorptivity of the dielectric structure. Our analysis shows that the thermal response of the system depends on both the elementary absorbers/emitters and the photonic reservoir characteristics. In particular, we investigate the modifications of the Planck blackbody radiation law, focusing our analysis on the possibility that the thermal emission from a photonic crystal may exceed the free-space radiative energy density. These modifications of Planck's law are achieved without altering the intrinsic properties of the absorber/emitter medium, which remain consistent with a frequency- and angle-dependent grey-body. We also evaluate the rate of spontaneous emission, stimulated emission and absorption for thermally driven two-level atomic systems in a photonic crystal, and introduce effective A and B Einstein's coefficients in the case of a photonic crystal.